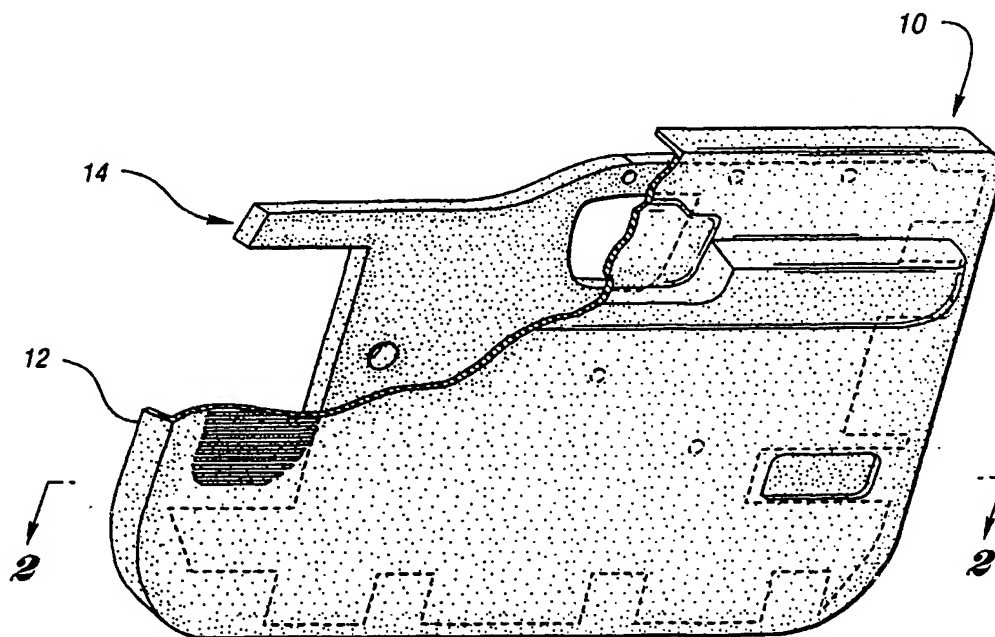




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(54) Title: RECYCLABLE INSULATED VEHICLE PART



(57) Abstract

An insulated vehicle part (10) has a recyclable substrate (12) of polyolefin and a recyclable insulation layer (14) recyclable with the substrate. The layer (14) includes polyolefin fibers, and has a substantially uniform density and a configuration which cooperates with the substrate (12) to attenuate sound and vibrations. The layer (14) is sonically welded to the substrate (12) at predetermined locations on its configuration.

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RECYCLABLE INSULATED VEHICLE PART

Technical Field

The invention relates to an insulated vehicle part having a recyclable substrate and recyclable sound and vibration absorbing insulation
5 attached to the substrate.

Background Art

Prior insulated motor vehicle door panels include a thermoplastic substrate and a non-thermoplastic insulation layer adhesively attached to the substrate. The insulation layer, which is typically made of such materials as cotton
10 fibers, rayon fibers and acrylic fibers, is not recyclable with the substrate. As a result, a door panel that is no longer useful must be discarded rather than recycled into a virgin thermoplastic material. Furthermore, because cotton fibers are friable, the insulation layer may require sizing to prevent dispersement of airborne cotton particles or dusting. This additional manufacturing step increases the cost
15 of the insulated door panel. Finally, because cotton fibers absorb moisture, odor and fungal growth may also be problematic under damp conditions.

Another construction of an insulated vehicle door panel is shown in U.S. Patent No. 5,345,720. The insulation layer in this door panel comprises rigid foam with numerous intricate bends. Because of its configuration, such an
20 insulation layer is relatively difficult and expensive to manufacture.

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Summary Of The Invention

5 The invention is an insulated vehicle part comprising a recyclable trim panel substrate and thermoplastic fibers for insulating the substrate. The fibers are recyclable with the substrate and are formed into a layer having a configuration which cooperates with the substrate to attenuate sound and vibrations. The layer is attached to the substrate at predetermined locations on its configuration.

10 Accordingly, it is an object of the invention to provide an insulated vehicle part which is recyclable as a unit.

Another object of the invention is to provide an insulated vehicle part which is substantially non-dusting.

Another object of the invention is to provide an insulated vehicle part which is substantially odorless under damp conditions.

15 Still another object of the invention is to provide an improved insulated vehicle part in which the insulation layer may be adhered to the substrate without using an adhesive.

It is yet another object of the invention to provide an improved insulated vehicle part which is relatively inexpensive to manufacture.

Brief Description Of The Drawings

FIGURE 1 is a perspective view of an insulated vehicle door panel according to the invention partly broken away to show insulation attached to a substrate of the door panel;

5

FIGURE 2 is a cross-sectional view of the vehicle door panel taken on line 2-2 of Figure 1, and showing the insulation attached to the substrate of the door panel;

FIGURE 3 is an enlarged fragmentary portion of Figure 2;

10

FIGURE 4 is a cross-sectional view similar to Figure 3 and showing a second embodiment of the insulated door panel according to the invention and including a backing layer attached to the insulation; and

FIGURE 5 is a cross-sectional view similar to Figures 3 and 4 and showing a third embodiment of the insulated door panel according to the invention and including corrugated insulation.

15

Best Modes For Carrying Out The Invention

With reference to the attached drawings, the preferred embodiments of the invention will be described. Figures 1 through 3 show an insulated vehicle door panel 10 according to the invention. The door panel 10 comprises a recyclable thermoplastic trim panel substrate 12 and recyclable insulation 14. The insulation 14 is configured to attenuate or absorb sound and vibrations, and is recyclable with the substrate 12 as described below in greater detail.

20

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The substrate 12 preferably comprises a thermoplastic such as polypropylene, and is made by conventional injection molding or by any other method known to those skilled in the art. Alternatively, the substrate 12 may
5 comprise any other suitable thermoplastic material which is capable of being recycled with the insulation 14.

The insulation 14 comprises recyclable thermoplastic fibers 16, which are randomly oriented to form a layer 18. The recyclable fibers 16 are preferably made of virgin or reclaimed homogeneous polypropylene, which is a
10 substantially non-friable material. Such material is available from Lear Corporation of Carlisle, Pennsylvania. Alternatively, the recyclable fibers 16 may be made of any other thermoplastic material which is capable of being recycled with the substrate 12, or other recyclable portion of a vehicle part, and which can be configured to sufficiently absorb sound and vibrations.

Because the recyclable fibers 16 are made of a substantially non-friable material, they are substantially non-dusting as compared with cotton fibers and cotton fiber blends. Consequently, there is no need to size or otherwise treat the fibers 16 to minimize dispersement of airborne particles. Furthermore, the fibers 16 are substantially odorless and do not promote fungal growth even under
15 damp use conditions. Consequently, the insulated door panel 10 is well suited for applications involving exposure to high humidity.
20

The layer 18 includes void spaces 20 which increase the sound and vibration absorbing capabilities of the insulation 14. The layer 18 preferably has
25 a substantially uniform density in the range of about 0.4 pounds per cubic foot (lbs./ft.³) to about 5.5 lbs./ft.³. This density range provides the necessary concentration and size of void spaces 20 between the fibers 16 to achieve a desired sound

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and vibration insulating characteristic. Alternatively, the layer 18 may be formed of any thermoplastic material which is capable of being recycled with the substrate 12, or other recyclable portion of a vehicle part, and which can be configured to sufficiently absorb sound and vibrations.

5 The layer 18 is preferably sized and shaped to cover substantially an entire side of the substrate 12, and is flexible so that it may be juxtaposed over substantially the entire side of the substrate. The layer 18 is preferably sonically welded to the substrate 12 at predetermined locations, but it should be appreciated that the layer 18 may be adhesively or non-adhesively attached to the substrate 12
10 in any manner known to those skilled in the art.

 To make the insulation 14, bails of tangled recyclable fibers 16 are carded or otherwise separated to substantially uniformly distribute the fibers. The fibers 16 are then inserted into a needle punch machine (not shown), such as is available from Fehra of Lintz, Austria. The needle punch machine, which
15 contains a plurality of vertically displaceable needles, randomly orients or mingles the fibers 16 to form the layer 18. The needling process is controlled to achieve the desired density of the layer 18. As the amount of needling increases, the density of the layer 18 likewise increases, while the size of the void spaces 20 decreases. Alternatively, the fibers 16 may be woven together or otherwise
20 arranged to form the layer 18. The layer 18 is then cut or otherwise shaped so that it may be attached to the substrate 12.

 Another method of making the insulation 14 involves blowing or air laying the fibers 16 onto a mat or other suitable surface to form the layer 18 having the void spaces 20. The fibers 16 used with this method preferably
25 comprise a relatively high melting temperature component and a lower melting temperature binder component. The layer 18 is then heated, such as in an oven,

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to melt the binder component and adhere the fibers 16 together. Alternatively, the fibers 16 may be blown onto the mat or other surface using heated air having a temperature sufficient to melt the binder component. It is to be understood that as an alternative to using fibers having a binder component, or in addition to using
5 such fibers, a separate binder material may be added to the layer 18.

Because the fibers 16 are not mechanically manipulated by a needle punch machine in the above method, relatively finer denier fibers can be used without risk of unacceptable breakage. By using finer denier fibers 16, the concentration of void spaces 20 can typically be increased compared with
10 insulation 14 made with a needle punch machine.

Figure 4 shows a second embodiment 110 of the insulated vehicle door panel including the substrate 12 and insulation 114. The insulation 114 includes a backing 122 attached to the layer 18 to improve the insulating capabilities of the insulation. The insulation 114 is preferably oriented so that the
15 layer 18 is sandwiched between the backing 122 and the substrate 12. In this configuration, the backing 122 and the substrate 12 cooperate to contain sound and vibrations within the layer 18. The backing 122 is preferably made of polypropylene, but it may be made of any other suitable thermoplastic material which is recyclable with the substrate 12 and the layer 18.

20 Figure 5 shows a third embodiment 210 of the insulated vehicle door panel including the substrate 12 and insulation 214. The insulation 214 has a corrugated layer 218, which comprises the fibers 16 and the void spaces 20. This corrugated configuration provides alternating ridges 224 and troughs 226, with additional void spaces 228 disposed between adjacent ridges and between
25 adjacent troughs. The size and concentration of void spaces 228 is dependent upon the degree of corrugation. These additional void spaces 228 may increase

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the sound and vibration absorbing capabilities of the insulation 214 when combined with the substrate 12.

5 The insulation 214 may be made with a pleating or corrugating machine having multiple conveyor belts that move at different speeds for folding the layer 218. Such a machine is disclosed in U.S. Pat. No.'s 4,576,853 and 4,111,733, which patents are hereby incorporated by reference. As another example, the insulation 214 may be made with a corrugating machine having a moveable blade for folding the layer 218. Such a machine is available from Struto, LLC of Dalton, Georgia. The degree of corrugation is controlled to
10 achieve the desired density of the insulation 214, as well as the desired concentration and size of void spaces 228. As the degree of corrugation increases, the density of the insulation 214 and the concentration of void spaces 228 likewise increase, while the size of the void spaces decreases.

15 In order to help maintain the corrugated configuration of the insulation 214, the fibers 16 may contain a binder component, and/or a binder material may be added to the layer 218. The layer 218 may then be heated to melt the binder component and/or the binder material, thereby adhering adjacent fibers 16 together. The binder material, if used, may be made of any suitable thermoplastic material that is recyclable with the substrate 12 and the insulation 214.
20 Alternatively, fibers 16 from adjacent ridges 224 and/or adjacent troughs 226 may be secured together, such as by entangling the fibers with a rotating spindle or other suitable device. In order to entangle or otherwise secure fibers 16 from adjacent ridges 224 and/or adjacent troughs 226, the layer 218 is preferably sufficiently corrugated such that adjacent ridges and/or adjacent troughs abut each other. Other means for maintaining the corrugated configuration of a pleated
25 material are disclosed in U.S. Patent No. 4,576,853.

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The present invention provides a structure in which there is no need to separate components prior to recycling. In particular, the thermoplastic components are easily reground and used to form new thermoplastic parts.

5 The invention has been described in an illustrative manner, and it is to be understood that the terminology which has been used is intended to be in the nature of words of description rather than of limitation. Obviously, many modifications and variations of the invention are possible in light of the above teachings. For example, the invention may be applied to other automotive interior trim components, such as window moldings and corner moldings. It is, therefore,
10 to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

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WHAT IS CLAIMED IS:

1. An insulated vehicle part comprising:
a recyclable trim panel substrate, and
thermoplastic fibers for insulating said substrate, said fibers being
5 recyclable with said substrate and formed into a layer having a configuration
which cooperates with said substrate to attenuate sound and vibrations, said layer
being attached to said substrate at predetermined locations on said configuration.
2. The insulated vehicle part of claim 1 wherein said substrate
comprises polyolefin, and said fibers comprise polyolefin.
- 10 3. The insulated vehicle part of claim 1 wherein said fibers are
woven together to form said layer.
4. The insulated vehicle part of claim 1 wherein said fibers are
needled together to form said layer.
- 15 5. The insulated vehicle part of claim 1 wherein said fibers are
blown together to form said layer.
6. The insulated vehicle part of claim 1 wherein said layer is non-
adhesively attached to said substrate.
7. The insulated vehicle part of claim 1 wherein said layer is
20 sonically welded to said substrate.
8. The insulated vehicle part of claim 1 wherein said layer has a
substantially uniform density.

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9. The insulated vehicle part of claim 1 wherein said layer has first and second sides, and one of said sides and said substrate are juxtaposed over substantially all of said one side.

5 10. The insulated vehicle part of claim 1 wherein said layer is corrugated.

11. The insulated vehicle part of claim 1 further comprising a backing attached to said layer.

12. An insulated vehicle part comprising:
a recyclable trim panel substrate of polyolefin, and
10 a recyclable corrugated insulation layer recyclable with said substrate and including polyolefin fibers, said layer having a substantially uniform density and a configuration which cooperates with said substrate to attenuate sound and vibrations, said layer further being sonically welded to said substrate at predetermined locations on said configuration.

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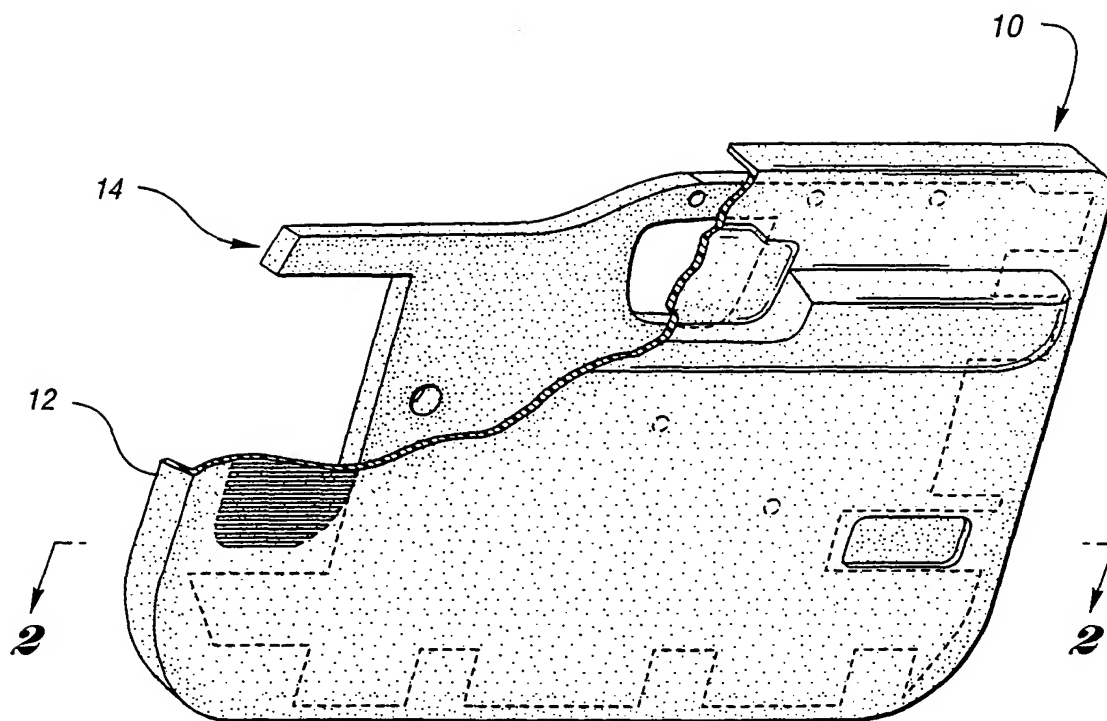


Fig. 1

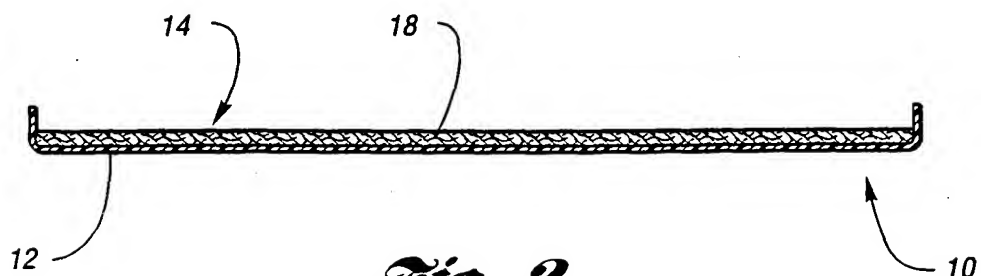
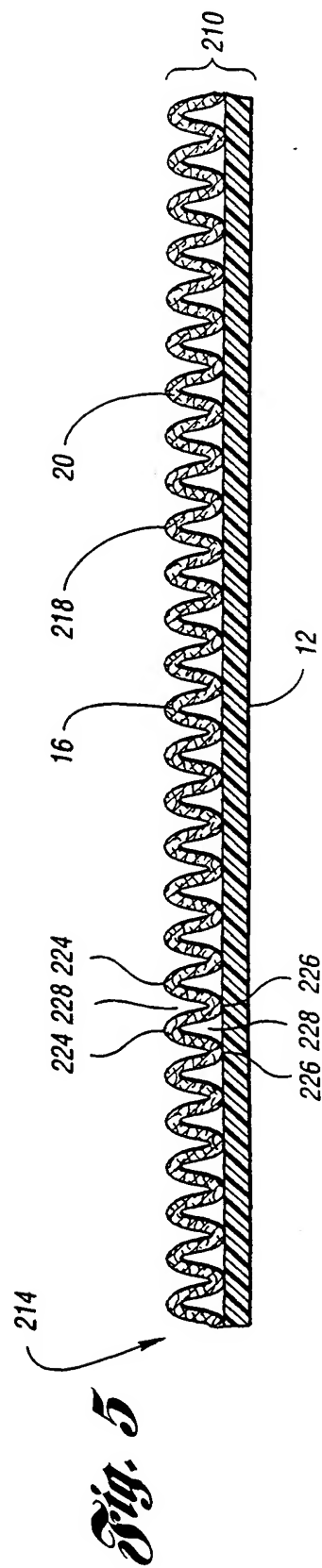
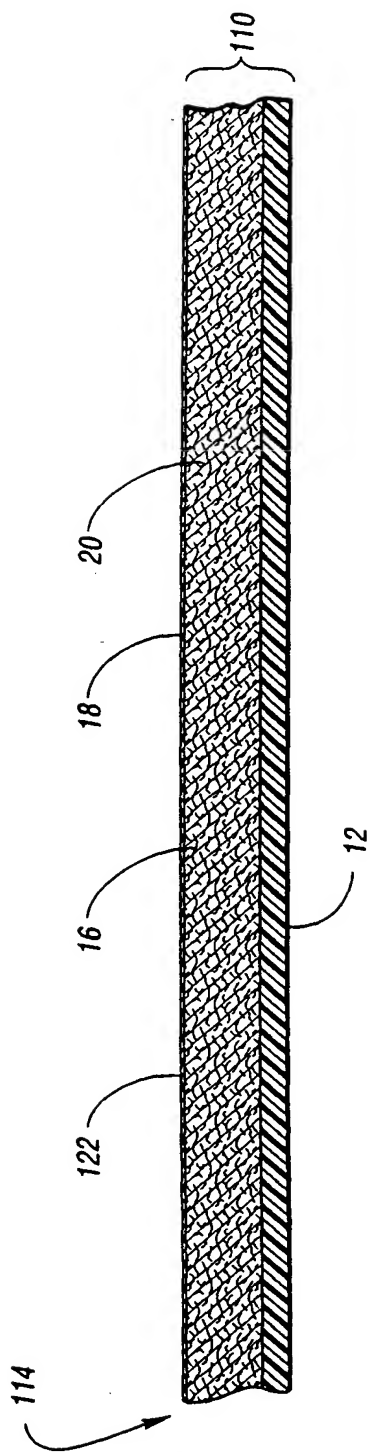
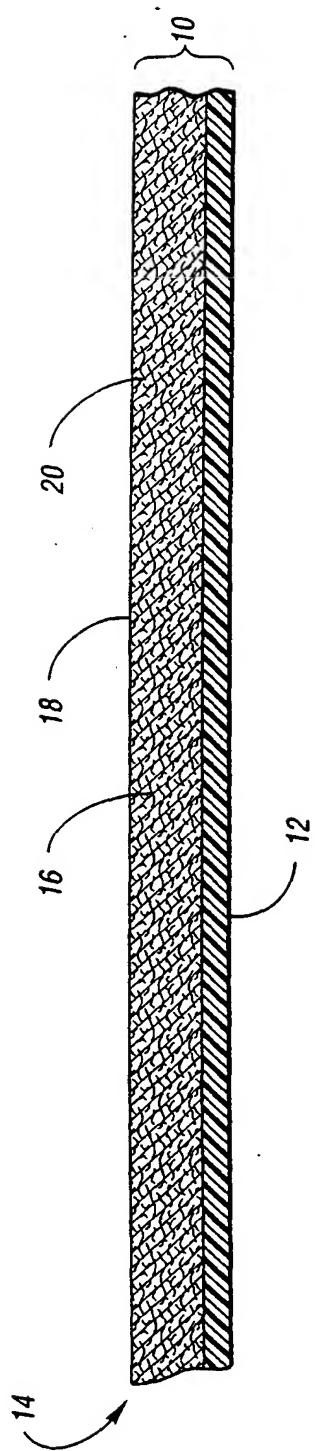


Fig. 2



INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 99/18873

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B60R13/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B60R B60J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 98 30375 A (OWENS CORNING FIBERGLASS CORP) 16 July 1998 (1998-07-16) page 2, line 18 - line 31 page 3, paragraph 2 page 4, paragraph 2 page 7, paragraph 2 page 29, line 3 - line 25	1-3
A	---	4-9, 11, 12
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A	---	2-4, 11
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

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European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040. Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Schaeffler, C

INTERNATIONAL SEARCH REPORT

International Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

International Application No

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